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It Should Be Easier and More Profitable for Textile Men to Cooperate in Research than for the Individually Small and Scattered Dry-Cleaners.

TEXTILE RESEARCH

EDITORIAL

Integration For and by Research

"THE necessity of creating products for which there is a profitable demand" is selected by Copeland and Learned, in their highly constructive report for the Textile Foundation on "The Merchandising of Cotton Textiles," as the most important of the three factors that they consider most essential to success in cotton textile merchandising. The others are as follows: "provision for specialization within organizations to permit adequate attention to merchandising," and "a unity of control over the marketing, production and financial functions of each business enterprise."

In other words, there may be integrated control of manufacturing, marketing and financing, and there may be adequate specialization in the merchandising organization, but lacking products for which a profitable demand exists, or may be created, success cannot be reasonably certain of attainment. These conclusions are sound and incontrovertible, but, while the creation of saleable products heads the list of factors necessary to success, that particular factor receives but minor consideration in the body of the report. Is it not possible, however, that this lack of coverage was intentional and justified by the lack of effort and outstanding achievement, and that the authors feel that consummation of the other two factors is essential for systematic, adequately financed and resultful development of saleable new products?

They must be well aware that the textile industry as a whole, and also its products, have been developed by try-and-reject, or empirical, methods extending over some 150 years, and that one of the industry's major needs today is new scientific knowledge

which may be applied to the development of new processes, finishes and products. They must know that the industry in this respect has been decidedly backward, particularly in this country; that it has made little effort to utilize scientific research as a tool of industry, as have practically all of our modern industries. They must have been aware, also, that the modern industrial units that have utilized scientific research most extensively and effectively have been of large integrated character. Is it possible that they believe that the cotton and other branches of the textile industry must get along without effective research until there is more general integration of existing units?

Their only specific reference to research is in connection with mechanical fabrics and appears on the front cover of this issue. It is followed by the suggestion that "mills using agents are likely to find it expedient to provide extra compensation for the agent which carries on effective research directly upon their products." This is not only a reasonable suggestion, but proves inferentially that the authors realize that much effective cooperative research could be done without unit integration as a prerequisite.

Fundamental scientific research is a non-competitive activity in which manufacturer, selling agent, broker, converter and finisher may engage cooperatively for the whole industry, or cooperatively by small related, but non-integrated, groups. Their continued failure to thus cooperate in larger numbers will emphasize the inefficiency of the existing non-integrated organization of the industry, and may prove an important factor in hastening the integration of its most efficient and progressive units.

Next Issue September 1

IN accordance with procedure when U. S. Institute's official publication was a mimeographed bulletin, the July and August issues of **Textile Research** *will be combined with an enlarged number to be published September 1, this issue to cover all important research matter that develops during the intervening period.*—**Publications Committee.**

Determination of Fibre Fineness

A Rapid Method Using a New Cross-sectioning Device

By J. I. HARDY *

THE process of making cross sections by mounting fibres in some imbedding medium, such as paraffin or celloidin, and cutting them on a microtome is not only too slow, but is also too expensive to be broadly applied. This has led to the development of more rapid methods, especially in the field of artificial silk. Johnson [1] pulled rayon threads through a conically bored hole in a metal block, cut off the fibres flush with the upper surface by means of a safety-razor blade and examined them under a strong reflected light.

Schwarz [2] drew fibres through thinner discs by means of a looped silk thread or fine wire and cut the fibres off flush with both surfaces of the disc. Viviani,[3] using an ordinary needle, formed a loop through a cork stopple and pulled a small bundle of the fibres through the cork. The fibres imbedded in the cork were sliced in thin sections with a razor. For drawing the loops through the cork, Herzog [4] recommended a crochet needle, while Bauer [5] found a sewing machine needle worked best. These methods, though rapid, lack refinement and are limited in their application. Barthlemy,[6] criticising the cork method on the basis that doubling of the threads rendered the method unsuitable for his purpose, recommended drawing the fibres through a slit in the side of a cork in order to make cross-sections. Niblack [7] drew fibres into a slit in heavy paper, cemented the paper to a microscope slide and then cut his cross-sections from the ends of the fibres with a sharp razor.

The writer, in search of a more satisfactory method, has undertaken to develop a device for holding the fibres, in order to make better cross-sections. In developing this device the

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writer has considered that it must be inexpensive, rapid in operation and yield clearly defined cross-sections with transmitted light in order to be used to best advantage in wool improvement operations as well as in the textile industry. While working with this device for making cross-sections, the writer has evolved a method of measuring fineness whereby distribution, shape and structure of the fibres are also observed when examined with an ordinary microscope. Drawings may be made or photomicrographs taken when such records are required.

The New Device and Apparatus

In this method the necessary cross sections are obtained by using an ordinary safety razor blade and the device illustrated in Fig 1. Both the fibre holder and slide holder are 3/64 inch (1.19 mm.) in thickness, while the diameter of the fibre holder is 1 inch (25.4 mm.), and of the slide holder 7/8 inch (22.2 mm.). The width of the fibre slot is 8.005 inch.

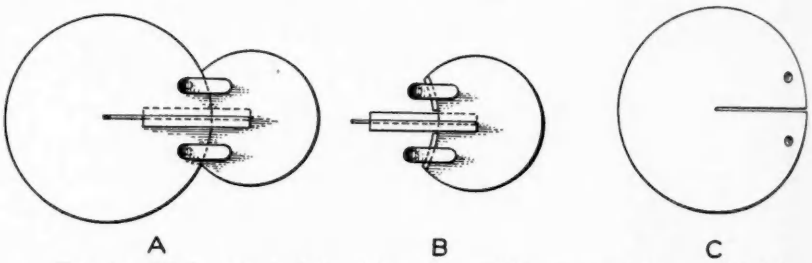

FIG. 1. Device for holding fibres for cutting cross-sections. (*A*) Top plan view of the whole device. (*B*) Top plan view of the slide holder (*C*) Top plan view of the fibre holder disc, showing the fibre slot.

This device involves the use of a metal disc called, for convenience, the fibre holder disc. In this there is a fibre slot which extends from the center of the disc to its circumference. The second disc is designated as the slide holder, in which is rigidly held a flat-surfaced metal slide with right-angled flanges. This slide extends sufficiently beyond the slide holder so that when it is in position the unfilled span in the bottom of the slot is of a known area. The other equipment consists of an ordinary microscope in the ocular of which is a celluloid disc containing three holes, a microscope lamp giving an intense light, a camera lucida, a camera for photomicrographs and the wool-fineness device reported by the writer [8] in an earlier issue of this journal.

Method of Use

A small group of wool fibres, after being cleaned with carbon tetrachloride and dried, is inserted into the fibre slot after the correct size of the group is determined by means of the fineness device,[8] by so adjusting this device that it will cut a lock of the correct size to fill the slot of the cross-section device without crowding. The size of the lock is established through trial cuttings and examinations of cross-sections under the microscope. The group of fibres should be sufficiently large just to fill the slot without disturbing any of the individual fibres when held in position by the slide holder. The fibres are cut off flush on both sides of the fibre holder disc by means of the safety razor blade. The photomicrographs were taken with a high-grade camera which takes pictures $1\frac{5}{8} \times 2\frac{1}{2}$ inches in size. The camera was attached to the microscope by means of a collar which was made from leather and adhesive tape. This makes a light-tight connection between the camera and microscope and is so constructed that the camera may be put on or removed at a moment's notice.

The area of the space holding the cross-section is 0.25344 sq. mm. and may contain as many as 700 fibres. To facilitate counting of the fibres an ocular is used in which there is a celluloid disc with three holes arranged in a straight line. Each of these holes covers 12.4 per cent of the area in which the cross-section is held. The fibres in the cross-section, which show through these holes, are easily counted by using a camera lucida, or they may be photographed and counted on the negative by placing it over a ground glass, illuminated from below. In a determination of the number of fibres showing through each hole, those fibres entirely within the circumference of the circle are counted as whole fibres and those partly inside and partly outside are counted as half-fibres.

By placing a piece of clear film over the negative, each fibre is identified as it is counted by an ink dot over it upon the clear film. It is appreciated that there is a slight mathematical error when each fibre touching the circumference of the circle is counted as a half-fibre; however, this error is very slight, amounting to less than one fibre in the case of the coarsest fibres, where the greatest error occurs.

Tests on Known Grades

In order to test the application of this method on known grades, samples of wool and mohair were obtained from the Bureau of Agricultural Economics. The wool samples were selected to correspond in diameter of fibre to similarly designated grades in the Official Standards of the United States for grades of wool. The mohair samples were selected to correspond to the diameter of fibre found in the tentative grades of mohair worked

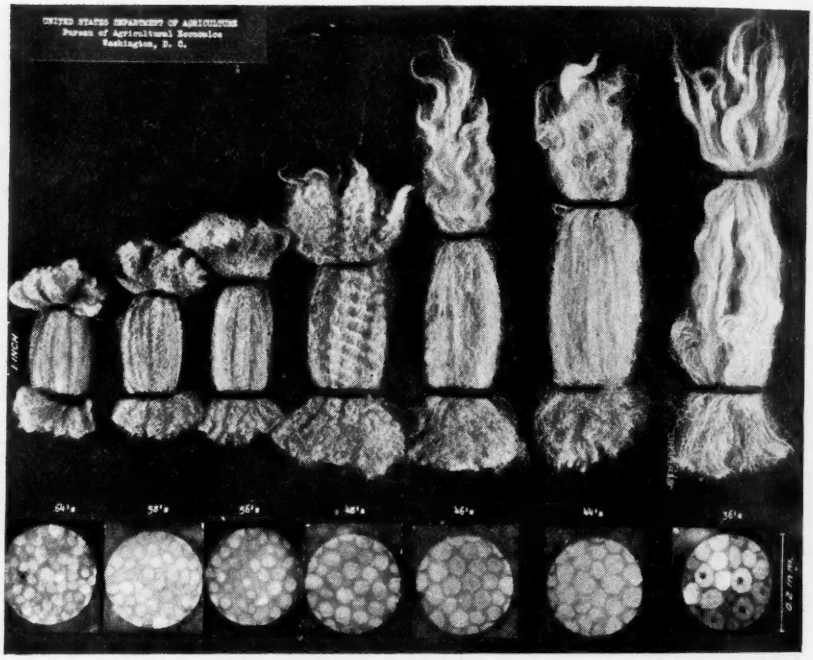

FIG. 2. Photomicrographs of seven samples of wool which correspond in fineness to wool of similarly designated U. S. Standards for Wool.

out by the previously mentioned Bureau. Fig. 2 shows the fineness of fibres in the cross-sections which were taken at a point midway between the base and tip end of each lock. The photomicrograph made of each sample cross-section to show fineness was made through three circular openings, one of which is shown for each different grade of wool. The number of fibres in each of these three holes was counted and is shown in Tables 1

and 2. It happens that there is one medullated fibre in mohair grade No. 1. This might have happened in any other grade but is usually associated with the coarsest grades of mohair.

Table 1

Number of wool fibres counted in each circle

"Fineness Quality"	64s	58s	56s	48s	46s	44s	36s
"Blood" Grades	Fine	½ Bld.	⅜ Bld.	¼ Bld.	Low ¼ Bld.	Com-mon	Braid
Circle Count No.							
1	58.0	44.0	39.5	26.0	24.0	18.0	18.0
2	57.0	43.0	40.5	27.0	24.5	20.0	17.5
3	55.5	44.0	42.0	26.5	23.5	21.0	18.5
Average	56.8	43.7	40.7	26.5	24.0	19.7	18.0
The average circle counts by this method for U. S. Standards for top, are	53.0	43.0	36.3	26.7	23.7	21.0	17.3

A similar count was made on the mohair fibres and is shown in Table 2.

Table 2

Number of mohair fibres counted in each circle

Grade	Kid	No. 1	No. 2	No. 3
Circle Count No.				
1	33.0	30.0	19.0	19.5
2	35.5	25.5	19.0	16.0
3	38.0	25.0	18.5	16.0
Average	35.5	26.8	18.8	17.2

Application in Cross-sectioning

The wide application of this device for making cross-sections is illustrated in Fig. 3. Numbers 1 and 2 are respectively cross-sections of about 100 denier and 300 denier artificial silk. Number 3 is of inferior grade commercial white hairs, often known as "chalky white," many of which are heavily medullated. Number 4 is a cross-section of hog bristles such as are used in tooth brushes. A unique feature of this device is that perfect definition of cross-section is obtained in the case of dyed fibres. Even jet black bristles stand out in clear relief. With such fibres the slide holder is withdrawn a trifle to permit the fibres to separate slightly from each other. By so doing each individual fibre in the cross-section stands out with its outline clearly defined.

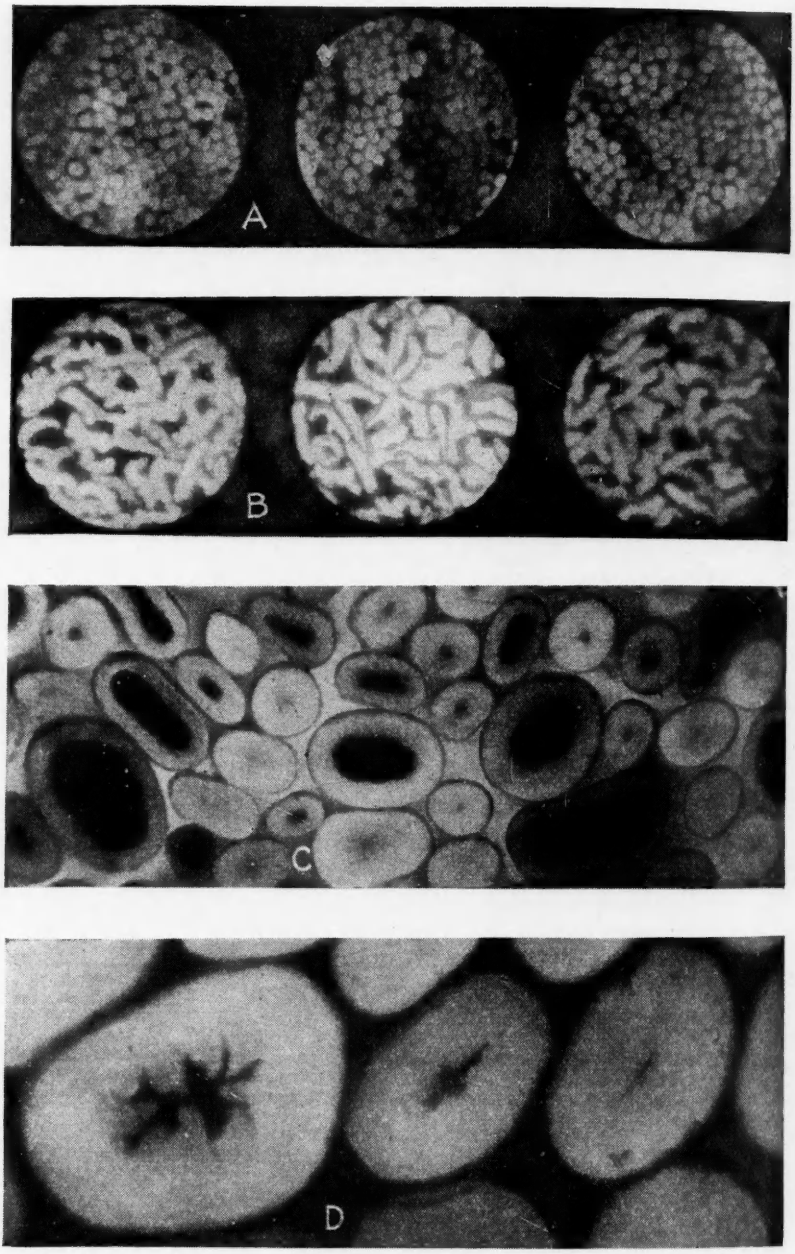

FIG. 3. Cross-sections of fibres of different fineness. (*A*) Rayon—100 denier (about), x 140. (*B*) Rayon—300 denier, x 140. (*C*) Commercial "chalky white" hair, x 140. (*D*) Hog bristles, x 140.

A wider slot was used for cutting sections 3 and 4 on account of the coarseness of these fibres. Still finer and coarser animal or vegetable fibres may be cut readily with this device. As the fibres increase in coarseness a slot must be used with sufficient space to accommodate these coarser fibres.

In addition to furnishing a quick way of obtaining fibre fineness, the photographs show graphically the distribution and structural characteristics making up this fineness. They may be readily filed away as permanent records and serve as a valuable aid in the study of the inheritance on wool or hair characteristics. Such photomicrographs may also be found valuable in many phases of the textile industry.

A public service patent has been applied for upon this device. The experimental work upon its development was conducted in the laboratories of the United States Department of Agriculture, although much preliminary work on this device was conducted in 1931 in Europe while the writer was holding a National Research Fellowship in the Biological Sciences.

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Effective Use of This Magazine

HAVING received an inquiry from a young man connected with the Botany Worsted Mills, Passaic, N. J., who stated that he was permitted by the management to read TEXTILE RESEARCH, we inquired of President Chas. F. H. Johnson as to how this was made possible. The simple but effective method is one that might be generally used by executives who are subscribers. Mr. Johnson writes:

"TEXTILE RESEARCH is passed around first to our General Manager, then to department heads and their assistants, and then to our general library, where this and other magazines are open to everyone in the mill."

The Flexometer,

An Instrument for Evaluating the Flexural Properties of Cloth and Similar Materials*

By Dr. H. F. SCHIEFER

An instrument is described with which the flexural work, flexural resilience, and flexural hysteresis of cloth, paper, sheet rubber, and similar materials can be evaluated. A pair of test specimens of standard dimensions are mounted in opposite angles formed by two vertical intersecting plates, one of which is fixed and the other movable on a spindle. The work done in folding the specimens to various angles between the plates, the work recovered when they are allowed to unfold, and the work lost are measured. These quantities are a measure respectively of flexural work, flexural resilience, and flexural hysteresis of the specimens. They are related to the stiffness and creaseability of cloth and affect the sensations which contribute to the psychological qualities of "handle" or "feel" and the "drape" of fabrics. Typical results are given.

I. Introduction

THE "handle" or "feel" and the "drape" of fabrics are of great importance to the user of textiles in clothing and home furnishings, as well as to the textile designer and the textile finishing mill. They are psychological qualities and are commonly expressed only in the vaguest of terms.[1] Obviously the first step in the development of means for evaluating them is to provide adequate methods for evaluating the physical attributes of cloth that affect the sensations which contribute to "handle" and "drape." The purpose of this paper is to describe an instrument, the Flexometer, for evaluating three of these attributes, flexural work, flexural resilience and flexural hysteresis. Flexural work, flexural resilience and flexural hysteresis are significant in other materials, such as paper, sheet rubber, patent leather, and varnish film. Typical results ob-

* This publication approved by the Acting Director of the Bureau of Standards of the U. S. Department of Commerce.

tained with the Flexometer for silk and cotton fabrics and for paper and sheet rubber are shown and discussed.

Other investigators have devised methods and instruments for measuring some physical characteristics of cloth that produce sensations which contribute to "handle" and "drape." Among the recent contributions may be mentioned a paper by Peirce on the handle of cloth as a measurable quantity.[2] Peirce measured thickness, weight and the angle to which a specimen of definite dimensions droops under its own weight. He also discussed the relationship of these quantities to drape, feel, harshness, compactness, fullness, thinness, and paperiness. Peterson and Dantzig have developed a quantitative method for evaluating the stiffness of starched fabrics and have studied the effect of different starches.[3] McNicholas and Hedrick have described a method for measuring the resistance to bending and the elastic recovery under flexure of cloth and applied it to the evaluation of parachute cloth.[4] Mercier has published a method for determining the coefficient of friction of fabrics.[5] Schiefer has described a method for evaluating the thickness, compressibility and compressional resilience of textiles.[6]

The general idea of the instrument to be described was suggested to the author by McNicholas as an improvement over the one described by McNicholas and Hedrick.[7] It is more sensitive than the instrument devised by Peterson and Dantzig and therefore can be used for delicate silk fabrics as well as for stiff cotton ones. Unlike the methods used by Peterson and Dantzig and by Peirce, the method to be described gives a measure of the amount of work done on the specimen in folding it through a definite angle. This value, the flexural work, is closely related to the stiffness of the specimen as appreciated by the fingers when the specimen is folded by them.[8]

The amount of work recovered when the specimen is allowed to unfold is also obtained. When expressed as a percentage of the work done in folding the specimen, this quantity is a measure of the flexural resilience of the specimen. So far as the author is aware, entirely satisfactory means of evaluating this characteristic have not previously been provided.

The difference between the work done in folding and the work recovered when the specimen is allowed to unfold, that is,

the work lost, is partially expended in deforming or creasing the specimen. This amount of work when expressed as a percentage of the work done in folding the specimen, called flexural hysteresis, is closely related to the creaseability of the specimen. The angular crease in the specimen and the amount of work which must be done to bring the specimen back to its initial position, which are measured with the Flexometer, are quantities also related to the creaseability of the specimen.

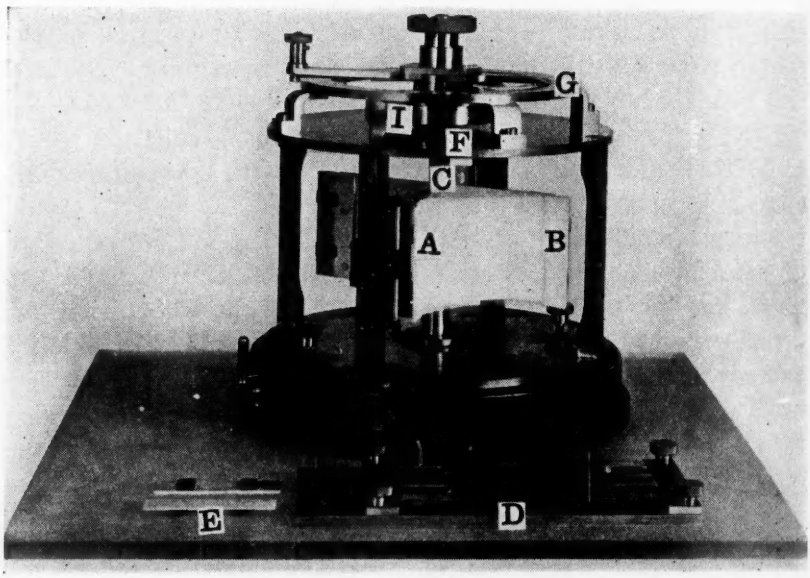

FIG. 1. The Flexometer. In this photograph the spiral spring was used to measure the torque. The spiral spring is mounted in the casing I.

II. Flexometer[9]

1. Description and Test Procedure

The Flexometer with samples inserted ready for test is shown in Fig. 1. Two fixed plates, *A*, 2 inches wide and 2½ inches long are attached to two diametrically opposite posts. A movable plate, *B*, 2 inches wide and 5 5/16 inches long, is mounted on a spindle, *C*, which rotates freely on a small steel ball. The specimen to be tested, 1¾ inches wide and 6 inches long, is placed carefully in the mounting clamp, *D*. The two small clamps, *E*, are given a thin coat of Canadian Balsam dissolved in benzol. They are then pressed against the specimen and

stick to it. The excess material at each end of the specimen is cut off, making the test specimen 4 inches long. The small clamps slip on the end of the fixed and movable plate as shown at *A* and *B*. The test specimen is tangent to each plate when mounted and will fold in the angle formed by the two plates when the angle between the plates is decreased by rotating the movable plate on the spindle.[10] As the specimen is folded between the plates, its resistance to folding or bending exerts a torque on the movable plate. For symmetry and to increase the torque exerted, a pair of specimens are tested simultaneously in opposite angles. The torque exerted by the specimens on the movable plate when they are folded to a certain angle between the plates is measured by the deflection of a calibrated spring which is attached to the spindle. The work done in folding the specimens through any small angle is given by the product of this small angle measured in radians and the average torque. If the torque is plotted against the angle between the plates, then the area under the curve bounded by any two angles is equal to the work done on the specimens in folding them from the larger to the smaller angle. The work recovered in unfolding is obtained in a similar manner.

2. Calibrated Springs

Calibrated spiral or cantilever steel springs may be used with the instrument to measure the torque exerted on the movable plate by a pair of test specimens. Both types have been used and found to be satisfactory. If cantilever springs are used, then several springs of different capacities may be mounted permanently. With a set of six springs whose capacities bear a ratio of 1 to 2, specimens whose resistance to bending vary in a ratio of 1 to 32 may be tested by merely changing a spring deflecting pin from one deflecting spoke to another. The springs are conveniently fastened to a hub at the top of the movable plate at an angular spacing of sixty degrees. Another hub with six spokes is fastened to a knob at the top. By placing the deflecting pin in any spoke at a constant distance from the center, the spring directly below it may be deflected. The angle through which the spring hub or movable plate is rotated is indicated by a pointer, *F*, on a scale graduated in degrees. The spring deflection is obtained from the reading of a second pointer, *G*, on a similar scale.

In Fig. 2 is shown a typical calibration curve for one of the cantilever springs. The spring deflection in degrees is plotted as abscissa and the torque in ergs per degree is plotted as ordinate. The combined friction in the spindle bearings of the movable plate, in the bearings of the calibration pulleys and at the contact of the deflecting pin and spring amounts to approximately 3% of the torque at maximum spring deflection. The effect of friction was eliminated in the tests by the method adopted for testing.

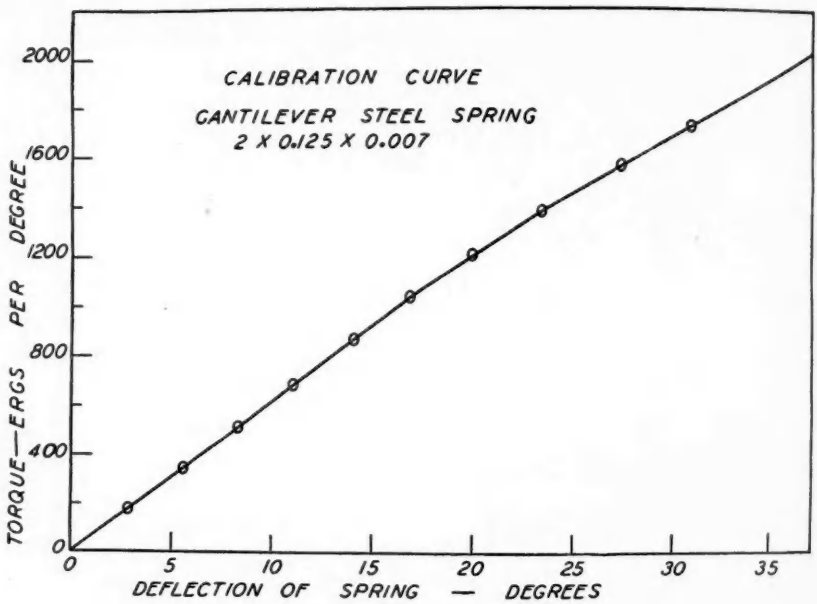

FIG. 2. Calibration curve of a cantilever steel spring.

The calibration curve for a spiral spring is similar to that of a cantilever spring. However, for a given torque the deflection of a spiral spring may be 10 to 20 times that of a cantilever spring.

If many specimens are tested with one spring, then a calibration table will facilitate the computations greatly and save much time.

III. Illustrative Data

In Figs. 3, 4 and 5 are shown typical curves obtained with the Flexometer for different materials and under different

methods of testing. The curves in Figs. 3 and 4 were obtained by using a spiral spring, and those in Fig. 5 by using a cantilever spring. All tests were made on specimens in equilibrium with an atmosphere of 65% relative humidity at a temperature of 70° F.

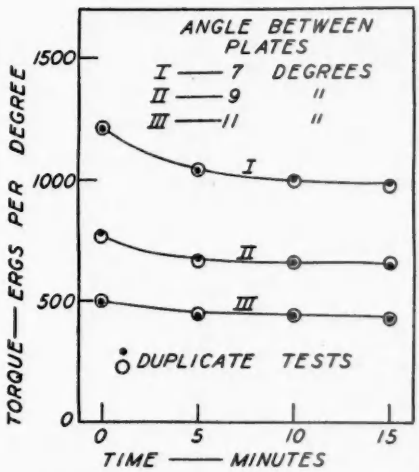

FIG. 3. Curves showing effect of time and angle between plates on the torque developed by pairs of test specimens of a silk fabric.

In folding a specimen in the angle between the plates of the Flexometer the spring deflection was determined when a given angle between the plates was approached from opposite directions. That is, when a specimen was folded to an angle of say 30° between the plates, the spring deflection was read as the angle was decreased to 30°. Immediately thereafter the angle was decreased 0.5° and the spring deflection was again read as the angle was increased to 30°. The same procedure was followed at the other angles during folding. The data given in this paper for folding are based upon the first of these two readings. In unfolding the specimen a similar procedure was followed, namely when the specimen was allowed to unfold to an angle of say 30° between the plates, the spring deflection was read as the angle was increased to 30°. Immediately thereafter the angle was increased 0.5° and the spring deflection was again read as the angle was decreased to 30°. The same pro-

cedure was followed at the other angles during unfolding. The data given in this paper for unfolding are based upon the last of these two readings. In other words, the data given in this

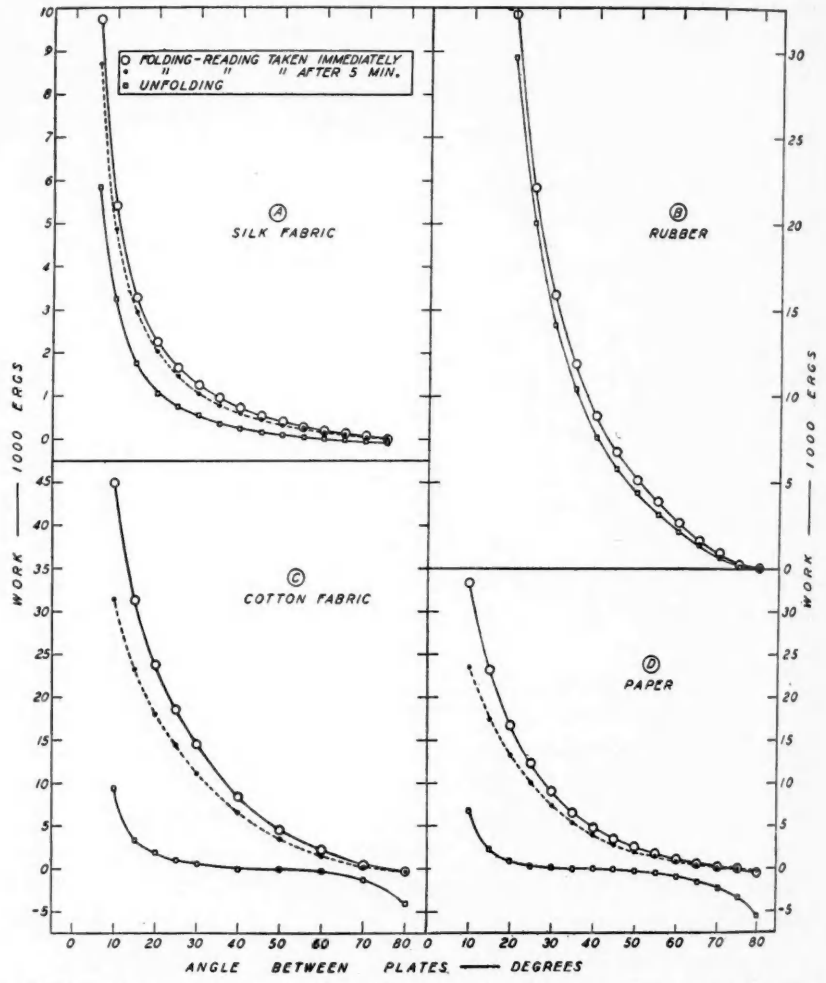

FIG. 4. Typical curves for the folding and unfolding of test specimens.

paper are based upon the spring deflections obtained when the movable plate was rotated clockwise. This method of testing was adopted to eliminate the effect of friction.

To show the effect of time and angle between the plates on the torque developed by test specimens when folded the following tests were made. Six pairs of specimens were cut from a

silk fabric with warp threads in lengthwise direction. Two pairs were folded to an angle of 7° between the plates. The spring deflection was noted immediately and after 5, 10 and 15 minutes respectively. Two other pairs were folded to an angle of 9° and the spring deflections were noted as above. The remaining two pairs were folded to an angle of 11° and the spring deflections were again noted as above. The torques corresponding to these spring deflections were obtained from the calibration table. The results are shown graphically in Fig. 3. The torque is plotted as the ordinate. It is expressed in ergs per degree, that is, the work, in ergs, that would be done if the torque acted through one degree. The variation in duplicate determinations is shown by the solid and open circles.

The curves in Fig. 3 show how the torque decreases with time when a pair of specimens of a silk fabric are folded to given angles between the plates. The greatest decrease in the torque occurs during the first five minutes and at the smaller angle. Only a small additional decrease in torque would be expected after 15 minutes. Similar measurements indicate that the decrease in torque is more pronounced for cotton fabric and paper, while no measurable decrease is observed for rubber. This is brought out in Fig. 4, where the work done on the test specimens in folding them to a given angle between the plates is plotted as ordinate and the angle as abscissa. The torque developed at any angle is equal therefore to the slope of the curve at that angle.

The curves *A*, Fig. 4, are for a silk fabric in which the warp threads were folded. A pair of specimens were folded to a given angle between the plates and the spring deflection was noted. The specimens were kept folded at this angle and the spring deflection was again noted at the end of 5 minutes. The angle between the plates was decreased 5° at a time and the spring deflections were noted as above. The results are shown by the curves through the circles and solid circles respectively. The spring deflections were also obtained at the same angles during unfolding, and the results are shown by the curve through the squares where the ordinate at any angle indicates the work recovered in unfolding. The decrease in spring deflection (torque) during the five minutes indicates that the

specimen is being creased. The difference between the work done in folding and that recovered in unfolding, expressed as a percentage of the work done in folding, is related to the creaseability of the test specimen.

The curves *B*, Fig. 4 are for folding and unfolding a specimen of sheet rubber. The spring deflections did not decrease by a measurable amount when the specimen was kept folded at each angle for 5 minutes. The curve for unfolding is slightly below the curve for folding, 92% of the work done in folding being recovered in unfolding.

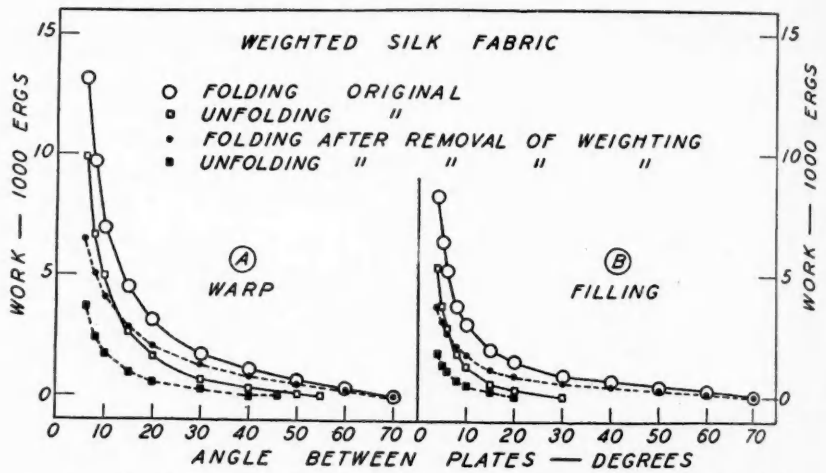

FIG. 5. Curves showing the difference between a weighted silk fabric and the same silk from which the weighting has been removed chemically and the difference between the behavior of warp and filling.

The curves *C* and *D*, Fig. 4, are for cotton fabric and paper respectively. They were obtained in the same manner as the curves for a silk fabric shown in 4*A* and for sheet rubber in 4*B*. The spring deflections decrease a greater amount when specimens of these materials are kept folded at each angle for 5 minutes. The curves for unfolding are greatly below the curves for folding indicating that these materials are more easily creased. Approximately 25% of the work done in folding is recovered in unfolding. The specimens unfold only to approximately 45° instead of to the initial angle of 80°. The crease in the cotton fabric and the paper specimens is not readily removed. To completely unfold these specimens to 80°, work

must be done which is shown as negative work recovered in their curves for unfolding. The permanent crease and the amount of work necessary to unfold the specimens to the initial position are related to the creaseability of the specimens.

The curves *A*, *C* and *D*, Fig. 4, show that the torque developed by the specimens of these materials when folded to a given angle between the plates decreases with the length of time the specimens are kept folded at that angle.

The curves in Fig. 5 show the difference between a weighted silk fabric and the same silk from which the weighting has been removed. The difference between the behavior of warp and filling is also shown. Specimens for test were taken from a tin weighted silk, weighing 4.7 ozs. per square yard and containing approximately 50% weighting material, and from the same fabric after the weighting materials had been removed chemically. The results for the warp and filling are shown in *A* and *B* respectively. The curve through the circles shows the amount of work in ergs done in folding a pair of specimens to various angles between the plates. The curve through the squares shows the amount of work recovered during unfolding. The dotted curves through the solid circles and squares are for the folding and unfolding of a pair of specimens taken from the same fabric after the weighting materials had been removed chemically.

IV. Discussion

In order to assign numerical values to the flexural work, flexural resilience and flexural hysteresis of different kinds of cloth or other materials to which the method is applicable, the dimensions of the test specimen and the minimum angle to which the specimen is folded between the plates of the Flexometer must be specified. The dimensions specified (4 inches long and 1¾ inches wide) were chosen simply because of their convenience. The angle to which the specimen is folded may not be chosen arbitrarily for it depends upon the thickness of the specimen. Thus a thick specimen cannot be folded in the Flexometer to so acute an angle as a thin one, and the angle which gives satisfactorily measurable results for a thick specimen may not be acute enough to give accurate results for a thin specimen.

In order to determine the angle to which a given specimen shall be folded, the assumption can be made that this angle is proportional to the thickness of the specimen. That this assumption is acceptable would be difficult to demonstrate for textile fabrics because of their complicated heterogeneous structure. However, it can be shown that the assumption is a good approximation for specimens of homogeneous isotropic material when the minimum angle between the plates is between 4° and 12°. For, if a thin specimen of homogeneous isotropic material is bent in a principal plane by forces applied at the ends

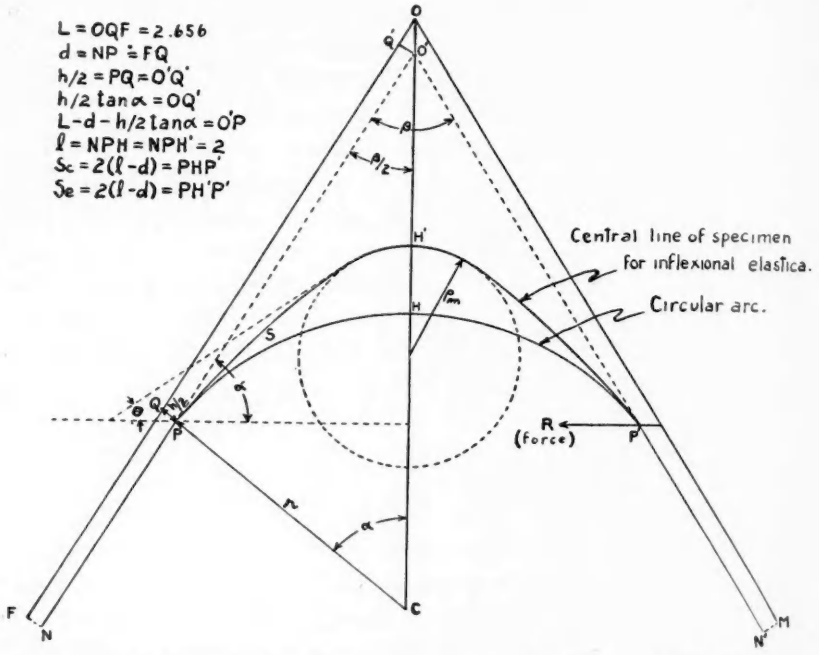

FIG. 6. Schematic diagram of test specimen and intersecting plates.

only, then the shape of the plane curve of the central-line is an inflexional elastica, whereas if it is bent in a principal plane by couples applied at the ends only, then the plane curve of the central-line is an arc of a circle.[11] Rigorous and approximate formulas for the inflexional elastica and for the circular arc are given below. For each case it is assumed that the results obtained are comparable when specimens of the same material

but of different thicknesses are bent until the maximum tensile stresses are equal. The last assumption simply imposes the condition that the specimens of different thicknesses, h, are bent until the minimum radius of curvature, ρm, of the neutral surface [12] is equal to some constant, n, times the thickness, h, or $\rho m = nh$.

Let O in Fig. 6 be the center of the spindle, OM the movable plate and OF the fixed plate. The angle between these two plates at any instant is denoted by β. Let $N\,P\,H^1\,P^1\,N^1$ be the central-line of the specimen when it assumes the shape of the inflexional elastica and let $N\,P\,H\,P^1\,N^1$ be the central-line of the specimen when it assumes the shape of a circular arc. Let h be the thickness, $2PQ$, of the specimen, S_e, the arc $P\,H^1\,P^1$ of the specimen for the inflexional elastica, and ρm, the minimum radius of curvature. Let S_c be the arc $P\,H\,P^1$ of the specimen for the circular arc of radius r. Then it follows that

$$r = \frac{L - l - (h/2)\tan a}{\tan a - a}$$

$$S_c = 2ar \text{ for the circular arc and}$$

$$\rho m = \frac{(L - l - (h/2)\tan a)\cos a}{2\sin a/2\,[2\,E\,\mathrm{am}\,K - (1 + \cos a)\,K]}$$

$S_e = 4\rho m K \sin a/2$ for the arc of the inflexional elastica where E and K denote the elliptic integrals of the second and first kind with modulus k given by the equation $k = \sin a/2$.[13] The symbols L and l are constants, L being one half the length of the movable plate or 2.656 inches and l one half the length of the specimen or 2 inches. The angle a is the complement of $\beta/2$.

The formula $\rho = 2h$ represents r within $\pm$ 6% for all values of β between 4° and 12°, and the formula $S = 6.2h$ represents S_e within $\pm$ 8% for all values of β between 4° and 20°, provided $\beta = 400h$. The formula $\rho = 2h$ represents ρm within $\pm$ 6% for all values of β between 4° and 12°, and $S = 10h$ represents S_e within $\pm$ 6% for all values of β between 4° and 16°, provided $\beta = 460h$. The angle β, $2(90 - a)$, is measured in degrees and the thickness h is measured in inches.

Similar approximate formulae may be obtained whe ρ is taken equal to some other constant times h. The value 2 was

chosen for the constant n because for this value the magnitudes of the quantities measured for very thin specimens were such as to be easily measured and reproduced.

The results given above justify the assumption that the minimum angle between the plates should be proportional to the thickness of the specimen, regardless of whether we assume the shape of the bent specimen to be circular or that of the inflexional elastica.

As previously mentioned, textile fabrics have a complicated heterogeneous structure. The arc of the bent specimen probably assumes a shape which lies somewhere between that of the inflexional elastica and the circle. Since $\rho = 2h$ represents very closely the radius of the circular arc when $\beta = 400h$, and represents very closely the minimum radius of curvature of the inflexional elastica when $\beta = 460h$, it is assumed that $\rho = 2h$ represents the minimum radius of curvature of the arc of the bent specimen when $\beta = 430h$. The arc of the bent specimen may then be represented by the formula $S = 8.6h$. To show the variations of the circular arc and of the inflexional elastica from the assumed shape, data for β, ρ and S are given in Table 1 for various values of h, and the percentage variations of r and ρm from ρ, and of S_c and S_e from S are given for these values of h.

TABLE 1

Values of β, ρ and S for various values of h.

h inch	$\beta = 430h$ degrees	$\rho = 2h$ inch	$S = 8.6h$ inch	$\frac{(r-\rho)100}{\rho}$ per cent	$\frac{(\rho m-\rho)100}{\rho}$ per cent	$\frac{(Sc-S)100}{S}$ per cent	$\frac{(Se-S)100}{S}$ per cent
0.0093	4	0.0186	0.08	4	−13	−26	3
.0186	8	.0372	.16	10	− 8	−23	7
.0279	12	.0558	.24	17	− 2	−20	10
.0372	16	.0744	.32	24	4	−18	14
.0465	20	.0930	.40	32	11	−15	19

The thickness [14] of a textile fabric may vary several per cent from place to place in the same fabric. It is, therefore, suggested that it is not worth while to measure the angle β closer than to the nearest half degree.

The arc given by the formula $S = 8.6h$ probably represents the arc of the bent specimen fairly closely. The area, volume,

and weight of the arc of the bent specimen are therefore known with the same degree of approximation. The work done on the arc, S, of the bent specimen may thus be expressed in terms of unit width, unit cross section, unit arc, unit area, unit volume or weight per unit area.

Definitions

The following definitions based on the foregoing discussion may now be proposed for the standardization of numerical expression of three physical attributes of fabrics:

The flexural work of a fabric shall be the amount of work in ergs done in folding a specimen 4 in. long by 1¾ in. wide to an angle β, measured in degrees, which is determined by the thickness of the specimen, h, measured in inches, according to the equation $\beta = 430h$.

The flexural resilience of a fabric shall be the amount of work recovered when the specimen which is folded as described above is allowed to unfold, expressed as a percentage of the work done in folding the specimen.

The flexural hysteresis of a fabric shall be the amount of work lost when the specimen is folded and allowed to unfold as described above, expressed as a percentage of the work done in folding the specimen.

It is evidently necessary in applying these definitions to specify the time consumed in folding and unfolding the specimen and the time it is allowed to remain folded. The previous history of the area included in the specimen is important. Imperfections of weave, creases, and other deformities may be expected to affect the result. A specimen taken from a small roll of cloth, or from a folded area, will not be representative of other portions that may have been kept flat. It is assumed that tests made with the Flexometer will be carried out on specimens that are in equilibrium with an atmosphere of 65% relative humidity at a temperature of 70° F., the standard conditions for textile testing.

The Flexometer should find use in the specification of the properties of fabrics required for given purposes. Mills which modify the flexural properties by sizing, weighting, and finish-

ing operations may find in the Flexometer a useful tool for the control of processes and standardization of products. The Flexometer should make possible quantitative studies of effect of variations in processes upon the flexural properties of the products.

V. Summary

An instrument called the Flexometer, with which the flexural work, flexural resilience, and flexural hysteresis of fabrics, paper, sheet rubber and similar materials can be evaluated, is described. Typical results in the form of curves showing the flexural characteristics of cotton and silk fabrics, paper, and sheet rubber are given.

The angle to which specimens must be folded to obtain comparable results depends upon the thickness of the specimens. An equation for determining the minimum angle for any given thickness of specimen has been developed.

Drawings of the Flexometer showing the details of construction may be obtained from the Textile Section of the Bureau of Standards.

References

1. Wm. D. Appel and the author are attempting to enumerate and define what may be called the kinaesthetic and tactile characteristics of cloth and the related physical properties.

2. F. T. Peirce. The Handle of Cloth as a Measurable Quantity. *J. T. I.*, Sept., 1930.

3. E. C. Peterson and T. Dantzig. Stiffness in Fabrics Produced by Different Starches and Starch Mixtures, and a Quantitative Method for Evaluating Stiffness. *U. S. D. A. Tech. Bull.*, No. 108, 1929.

4. H. J. McNicholas and A. F. Hedrick. The Structure and Properties of Parachute Cloths. National Advisory Committee for Aeronautics Tech. Note, No. 335, 33 pp., 1930.

5. A. A. Mercier. Coefficient of Friction of Fabrics. *B. S. J. Rsch.*, 1930, 5, 243–6; Research Paper No. 196.

6. H. F. Schiefer. The Compressometer, An Instrument for evaluating the Thickness, Compressibility and Compressional Resilience of Textiles. *B. S. J. Rsch.* In press.

7. See footnote 44. In their method a strip of fabric 3 inches by 9 inches in size is folded back upon itself and the height of the fold is measured when the fold is compressed by various loads. Similar measurements are made during unloading.

8. Peirce assumed that the flexural rigidity, G, of the specimen is a measure of the stiffness as appreciated by the fingers. He computes it from the weight of the fabric per unit area, w, and from the angle, θ, to which a specimen of definite length, l, droops under its own weight, by the formula

$$G = \frac{wl^3 \cos \theta/2}{8 \tan \theta}.$$

9. Wm. D. Appel gave a brief description of the Flexometer before Committee D-13, American Society for Testing Materials on Mar. 13, 1930. This was published in *Textile World*, Mar. 29, 1930, P. 61.

10. For paper and starched fabric the specimens may be mounted so that they will fold outside of the angle formed by the plates. This should be done whenever no crease or set is desired in the specimens.

11. The Mathematical Theory of Elasticity by Love, Fourth Edition, pp. 399–404.

12. By neutral surface of a bent specimen is meant that surface in which the elements suffer no deformation in the direction of length. For a homogeneous specimen it is midway between the two external surfaces.

13. See footnote 11.

14. Thickness shall be measured according to the standard method. See footnote No. 6.

Survey of Textile Education

A STUDY of textile education with the objective of coördinating the work of the various schools in this country is to be undertaken by the Textile Foundation, according to a statement made by Stuart W. Cramer, treasurer of the Foundation, at the recent convention of the American Cotton Manufacturers Association.

Mr. Cramer referred to the fact that the American Association had given considerable time and thought to textile education and had authorized in 1924 and 1925 the appointment of committees to coöperate with the textile schools, recognizing the lack of standardization of textile school work. Mr. Cramer stated that the Textile Foundation had selected an advisory committee to organize and conduct this study, and that the committee is engaged in selecting a competent man to have active charge of the survey of all the textile schools and of their work. The personnel of the advisory committee is as follows: Dr. Karl T. Compton, president, Mass. Institute of Technology; Dean Robert E. Doherty, Yale University Engineering School; Dr. E. C. Brooks, president, State College, Greater University of North Carolina.

As soon as the survey has been completed the advisory committee will report to the Textile Foundation their recommendations as to what should be done in the way of standardization by the different textile schools. Their recommendations will then be submitted to the different textile schools, at a meeting to be called for that purpose, in the hope and expectation that this important phase of our industry will be brought up to the highest possible standard.

"Merchandising of Cotton Textiles"*

By COPELAND and LEARNED

This is the second of a series of studies of textile distribution, conducted under grants of the Textile Foundation, Inc. "The Commercial Problems of the Woolen and Worsted Industries," by Paul T. Cherington, was completed and published last year. Another for the silk industry is in progress.

The following digest of "Merchandising of Cotton Textiles" has been prepared by the authors. The complete report, however, of less than 35,000 words, represents maximum condensation to meet the needs of the busy executive and yet provide adequate and clarified coverage. Although specifically a study of cotton textile merchandising, it merits the study of all who are interested in correct merchandising principles.

Chapt. I—Introduction

THE objective of this report is the study of merchandising methods and organization in the cotton textile industry in the United States. One purpose was to ascertain whether there were any merchandising practices in the cotton textile industry which tend to cause chronically unwholesome conditions and which therefore add to the vulnerability of the industry during periods of general adversity such as now exist. The report considers the effects of the current depression upon the organization of the cotton textile industry. Its chief concern, however, is with the explanation and possible improvement of the persistently unsatisfactory conditions of the last 13 years. Therefore, the study of merchandising methods and organization was not based simply on 1932 conditions but primarily emphasis was given to the methods of organization and the merchandising policies pursued before 1930. The conclusions of the report are based on conditions prior to the depression and are applicable to the normal operation of the cotton textile industry.

* Merchandising of Cotton Textiles. By Melvin T. Copeland and Edmund P. Learned. P. 100. Harvard Graduate School of Business Administration, Soldiers Field, Boston, Mass. Price, $1.50.

The task of merchandising is to ascertain the characteristics of the merchandise for which there is a potentially profitable demand, to prepare instructions for the manufacturing plant in order that it may be able to produce goods for which a demand exists, to aid in developing plans for promoting the sales, and to supervise various routine operations in connection with these activities. Viewed differently, the essential problem of merchandising is to determine what to make, how much, at what time, and at what price. The study of these problems of merchandising in the cotton textile industry leads also into related questions of sales solicitation and general organization and opens up certain questions of major policy in the industry.

The management of the cotton textile industry is in the hands of men of at least average business ability. The management cannot be fairly indicted on grounds of general incompetency. The reason for the basic difficulties of the last 13 years therefore must be found elsewhere.

Since the cotton industry operated year after year at a higher percentage of capacity than was attained by many other industries that were prosperous, the troubles of the cotton manufacturing industry cannot reasonably be dismissed simply on the grounds of excess capacity. The causes of the trouble are more deeply rooted.

The task undertaken, therefore, in the body of the report is to ascertain whether on close examination the merchandising methods and organization of the industry reveal any serious weaknesses which might account for some of the difficulties of the last decade.

The survey was conducted by interviews with executives of grey goods mills, integrated companies, selling agents, firms of converters, brokers, finishers, retailers, wholesalers, mail order companies, association executives, and others interested directly or indirectly in the cotton textile industry. The organizations studied were representative of the variety of conditions which prevail in the industry. Various companies in other industries also were visited in order to ascertain what might be learned from their merchandising experience that would be of value to the cotton industry.

In Chapters II to VI inclusive, a statement is presented of

typical merchandising problems for various sorts of cotton goods, and without revealing the identity of the sources of information, detailed explanations are given of the manner in which numerous firms have organized to handle their merchandising jobs. Since the industry shows such a variety of situations, the authors have chosen to present many details rather than to seek acceptance of their general conclusions without a comprehensive exhibit of their evidence. For anyone interested in general conclusions, Chapters I, VII and VIII should be read. For those wishing in addition the concrete statement of evidence the intermediate chapters should be read. These chapters also include constructive suggestions on merchandising and sales opportunities. Chapter I also in addition to introducing the subjects gives a partial summary of conclusions which, however, are more adequately developed and supplemented in Chapters VII and VIII.

Chapt. II—Merchandising Organization and Methods for Household Products

The purpose of this chapter is to describe and appraise the organization and merchandising methods employed by selling agents and mills for sheets, blankets, and towels. The first part of the chapter describes the merchandising problems for these three commodities, pointing out the nature of the merchandising task of each one, indicating the merchandising opportunities overlooked, and the need for promotional work on the part of the mills and distributors. The second part of the chapter presents an example of each type of organization handling these products. A summary at the close of the chapter includes a statement for these commodities, of the organization methods and policies of all the companies interviewed.

The chapter contains numerous examples which show the desirability of approaching the product planning problem from the point of view of the consumer or user. The authors state that a more universal appreciation of the consumers' attitude would lead to the more profitable sale of household goods. The nature of the promotional opportunity and the burden of such work is developed.

One of the chief difficulties with the organizations in this section of the industry is that merchandising executives are re-

sponsible for so many routine details that frequently they do not have adequate time for product planning activities. How the more successful companies overcome this difficulty by providing for specialized management of sales and merchandising either by trade outlets or on a single commodity basis is indicated in the organization discussion.

Chapt. III—Merchandising Organization and Methods for Style Merchandise

The merchandising of style cloths, one of the most difficult problems of the cotton textile industry, is the subject of this chapter. The complexity of the market for style cloths and the need for some form of specialization in order to allow individuals to cope with narrow aspects of this large problem is apparent in the discussion. An outline of marketing functions for style goods is presented. This outline is really a composite view of the industry's own idea of its merchandising problems for style goods. The first section of this outline on layout of line, or what may be termed creative merchandising, is discussed at considerable length in this report with examples drawn from the fields of dress goods and draperies. Incidental to the discussion of the outline there is a statement on the place of commercial designers in the organization of the cotton textile industry. Illustrative topics in this discussion of merchandising problems are as follows: study of uses of product of fundamental importance, appraisal of fashion trends, sources of fashion information, style juries, pattern policy for percales, determination of number of patterns, study of retail and wholesale price lines, and troublesome competitive practices.

After the discussion of merchandising problems, the authors present their evidence on the methods of organization pursued for style goods. This discussion is composed of a description of the methods employed by organizations operating few product departments. As a result of this analysis of converters and integrated companies, a tentative conclusion is established that specialization by type of trade outlet or product is one basis of success in style goods.

The evidence with respect to companies merchandising many products indicates that they too may produce a variety of goods

successfully provided they set up some form of internal organization which gives them the advantages of the types of specialization which characterized the first group of companies.

The detailed discussion of individual organizations gives one example of each of the variety of successful methods tried by companies in the field of style goods. The chapter ends with a summary of the practices of all the organizations studied and five conclusions with respect to successful organization methods for style goods.

Chapt. IV—Merchandising Methods and Organization for Men's Wear

Men's wear, including such products as shirts, suitings, underwear, night wear and work clothing, is the final division of the consumers' finished goods market for which merchandising characteristics and problems are reviewed. A cursory survey of the field of men's wear gives the impression that price is the dominant motive back of most retail promotions of cotton men's wear. To what extent the effort to expand demand by the appeal of lower price has merely shifted sales from one price bracket to another, or how far lower prices have been attained at the expense of quality, are open questions. The efforts of laundry associations to encourage quality purchases by the consumer are noted. The fact that many qualities of a shirt cannot be judged by the customer at the time of purchase creates a promotional opportunity and provides the basis for brand discrimination by the consumer. The relation of these developments to mills which allow cutters to use labels is pointed out. The difficulties of overcoming objections to the use of men's cotton suitings also are described in some detail, and the basic necessity for establishing consumer satisfaction in use for men's cotton wear, both for dress and for work clothing purposes, is indicated. This chapter includes a description of representative organizations merchandising cloths for the field of men's wear. The fact that a merchandise executive may have too many lines to watch, or too many functions to perform, to do a satisfactory job does not seem to be appreciated fully by the majority of companies in this field.

Chapt. V—Merchandising Methods and Organization for Grey Goods

The first section of this chapter deals with the merchandising characteristics and problems for standard constructions, fancy weaves, and industrial goods whether grey or finished. The place of brokers in distribution of grey goods is described. The second section of the chapter discusses representative organizations merchandising fancy weaves, and concludes that the selling agents organized to handle fancy weaves generally do so more effectively than do the mills which sell their own products through brokers. With some exceptions the mills which rely on brokers for the most part fail to realize that the burden of establishing a merchandising organization is theirs. They have therefore taken a passive attitude toward creating products. At one time the mills making fancy weaves used selling agencies in order to obtain financial assistance; the use of brokers whose commissions were lower than those of the selling agencies was not a practical consideration to the mills. Selling agencies, however, in order to hold or to obtain the accounts of strong companies saw the need for rendering merchandising as well as financial services and have taken a more aggressive attitude than many of the grey mills using only brokers. The following sections discuss representative organizations merchandising both standard and fancy grey cloths, organizations handling carded greys and industrial cloths, and, finally, representative organizations selling industrial products chiefly. A summary on grey goods merchandising is included, after which the whole question of the use of selling agencies is introduced.

In the discussion of the agency system reference is made to the inadequate training and the typically deficient management of salesmen, the effects of retrenchment during the depression, and the emphasis on mill profits by the selling agencies. The flat commission of agencies is considered unwise. The suggestion is made that a new approach to the question of compensation of agencies be considered. The marketing task to be accomplished should be defined; the cost of carrying out this plan should be determined and then converted into a percentage of estimated sales, such arrangements to be reviewed each year or as often as the principal and agent wish.

In the comments on selling agencies the authors clearly show that they are not criticizing individuals but a system. For example, they criticize mills for their flat refusal to cooperate with agencies with respect to matters of mill costs and of inventory control. They show that many mills, in their desire to attain economy in production cost, create stocks of merchandise that further depress the level of prices. The weaknesses of the agency system and suggestions for its correction are developed further in Chapter VII.

Chapt. VI—Merchandising Methods and Organization for Cotton Yarn

This subject is treated less exhaustively than some of the others. The nature of the yarn market and a description of the sellers of yarn is included in the first part of the chapter. Yarn marketing organizations are discussed under the heads of direct selling mills, yarn selling agencies, yarn mercerizing organizations and yarn brokers. Throughout the chapter the distinction between the problems of combed yarn and carded yarn is pointed out. The practices in yarn marketing, such as short selling by agencies or merchants and promiscuous selling by mills, are condemned. The real solution of the difficulties depends partly upon the willingness of small mills to transfer to more competent executives the control of their merchandising, sales, production and inventory problems. The organization of the yarn market has elements of weakness today which formerly were characteristic of the cloth selling market. In the cloth market these weaknesses were stamped out by the combined efforts of mill managements and the leading selling agencies.

Chapt. VII—Conclusions on General Organization

The purpose of this chapter is to review the findings of Chapters II to VI inclusive and to consider their implications with reference to the problems of general company organization. The authors discuss the point of view and the organization methods which enable an individual company to enhance its position in a highly competitive industry. In the last chapter they consider the relation of merchandising to the general prosperity of the industry.

The authors insist that in summarizing the methods of organization they make no attempt to list the secrets of success, for the doing of the job requires a deeper understanding than the statement or reading of such a list. Furthermore, they warn the readers of the report that the adoption of an organization corresponding to any which they commend easily may prove to be an empty shell, unless the executives who administer the organization thoroughly comprehend the job itself and in turn employ others who appreciate the nature of the task confronting them.

Next, a discussion of the complete separation of merchandising and selling as a method of organization is presented. Advantages of this plan and the limitations surrounding its use are noted. Then they consider the conditions under which coordination of merchandising and selling is effected in senior officers, and under which the departmental merchandise managers are freed from the burden of sales supervision. The advantages and disadvantages of this plan of organization are also presented. Finally, they list the conditions under which a third plan of combining merchandising and selling responsibility may function satisfactorily. The evidence indicated that with few exceptions the firms which assign combined merchandising and sales jobs to their department managers are not securing as good results as are obtained by those which afford their merchandise managers freedom from routine sales work. If the dangers of unbalanced emphasis, which characterize this combined responsibility, are to be avoided, special care must be exercised either in the organization set-up or by other means. Five sets of circumstances under which the combination of selling and merchandising responsibility apparently is successful are listed with some discussion.

After the preceding review of the combination of merchandising and sales responsibilities, the possibilities for staff departments in the organization of cotton companies are reviewed.

The remainder of the chapter is devoted to further discussion of the marketing methods of selling agencies. The report shows that some of the selling agencies follow principles of organization similar in character to those followed by merchant converters and successfully integrated companies; namely, either

they specialize on narrow product lines and thus give full-time attention to a restricted section of the market on which they may become thoroughly informed and expert; or they obtain the same result by means of internal organization. Then the report reviews the weaknesses in agency organization, some of which were mentioned in Chapter V and others were not. This is followed by a statement of the constructive services performed by agencies. Lastly, they list the obstacles to the success of the agency system. In spite of the advantages of the selling agency system, its long historical background and the genuine efforts of many agencies to do a satisfactory job of marketing, the report concludes that agencies are trying to do a good job under impossible conditions and that the selling agency system is an outmoded method of marketing cotton textiles. The obstacles to the success of the system from the point of view of agencies and also from the point of view of mills are such that, without a change in organization structure, lack of balanced control—the outstanding weakness—cannot be overcome.

In many instances the continuance of the agency system means that many mills in the cotton textile industry will continue to operate without real chief executives. Mill managements have charge of production; selling agencies supervise the selling and merchandising; and financial questions are handled by one or the other. The chief executive, whose duty it is to coordinate the sales, production, and financial activities of the company, is lacking in this arrangement. The report recommends that the functions of production, sales and financial problems properly belong under one control and one ownership interest.

The report shows that small companies in the industry cannot give up selling agencies. These companies cannot afford to assume the function of direct marketing themselves unless they are merged with other companies to form a single organization large enough to be economical and capable of effective specialization in merchandising, yet small enough to be flexible. Several paragraphs are devoted to the question of the nature of flexibility. The report indicates that the desirable integration of marketing, production and financial functions may be obtained by groups of mills joining in common new companies, or by selling agencies continuing to increase their ownership in mills until they have full control.

Chapt. VIII—Conclusions on Relation of Merchandising to the Prosperity of the Cotton Industry

The question asked in this chapter is whether the explanation of the lack of prosperity of the cotton textile industry during the last decade lies in the failure of the industry to make prompt adjustments to changes in consumer demand. The authors believe that improved merchandising methods and policies will not automatically correct all of the troubles of the industry. This chapter reviews the obstacles which must be overcome before improved merchandising methods and organizations can have full effect.

The question of capacity to produce within the industry is reviewed. The need for a new philosophy of management for the industry which matured during the past decade is pointed out. The profitless volume mania characteristics of the industry are unlikely to be overcome so long as the structure of the industry remains as it is. Of the three possibilities of improving the situation, that is (1) voluntary cooperation, (2) cutthroat competition, and (3) the formation of larger companies, the authors conclude the first is unlikely to be successful; the second has been partially effective and the third is the most desirable goal of all.

There is no mechanistic solution that will solve the problems of the industry and the implied suggestion that further integration is desirable is not to be considered as a panacea. Integration in the cotton textile industry has several aspects: (1) the common ownership of production and sales divisions which was endorsed in Chapter VII, and (2) the number of productive functions to be performed by a single organization; that is, the question of whether a mill should perform all the functions of merchandising and thus produce finished goods. The advantages and disadvantages of the integration to the point of finished goods production are reviewed with the conclusion that ultimately such integration is desirable.

The most important conclusions of the report lay emphasis on three factors essential in the long run to success: first, the necessity of giving primary emphasis to the consumer viewpoint in creating products; second, provision for specialization within organizations to permit adequate attention to merchandising; third, a unity of control over marketing, production, and financial functions of each business enterprise which can be accomplished only by an integration of mills, selling houses, and converters.

"Pointer Readings" of Science

By L. A. HAWKINS*

EDDINGTON, the well-known English physicist, has said that all science consists of "pointer readings." He means that all scientific knowledge is derived from measurements, and only those things that can be measured come within the limits of science.

It is largely by devising new instruments to give new or better "pointer readings" that science advances. If man's knowledge were limited to the field which can be explored by his unaided senses, science would still be back in the dark ages. Even a casual visitor to any modern laboratory must be impressed by the facilities for making measurements of a kind impossible even one generation ago.

The X-Ray Spectrograph

For instance, a skilled mechanic with his steel scale can measure to about one one-hundredth of an inch. By using micrometer calipers he can measure nearly to a ten-thousandth of an inch. We now have electric gauges that will indicate a millionth of an inch, but to know the spacing of atoms in a crystal we go to the X-ray spectrograph which measures distances a hundred thousand times smaller than those the electric gauge can indicate—distances so small that they bear to one inch the same ratio that one-hundredth of an inch bears to the diameter of the earth.

Langmuir's Accomplishment

We have sensitive vacuum gauges in our laboratory, gauges which will measure down to a trillionth of an atmosphere, but the methods of measurement developed by Langmuir in his study of adsorbed films far surpass our best vacuum gauges. He can

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detect one atom of caesium in a cubic meter of space. That would correspond to detecting the presence of one small fly in a hollow sphere the size of this earth. Using the same analogy, we could say that a cubic meter filled with gas at atmospheric pressure could be represented by a hollow sphere the size of this earth, with about seven hundred small flies in each cubic foot, flying about at enormous velocities and colliding at enormous frequencies. Now if we drive those flies out until there is only one left to each ten cubic miles, we would have a condition representing the limit that our vacuum gauge can measure, but there would still be about twenty billion flies in our sphere. Now drive out all but one of those twenty billion flies, and Langmuir's method will still detect that lonely fly. It was such refinement of method which enabled him to develop the new fundamental chemical theory which he described when he received the Nobel prize last December.

Billionth of a Billionth Ampere

But perhaps the greatest refinement has been reached in measuring electric current. We now have vacuum tubes which can detect a billionth of a billionth of an ampere. This corresponds to about six electrons per second, or, to put it more strikingly, if we let the current in a fifty watt lamp represent the flow of Niagara River, then this minute current, which we can now measure, would be represented by a trickle of one drop in five years.

Appointed to Abstract Committee

In recognition of his valuable services as an abstractor of chemical publications for TEXTILE RESEARCH, M. W. Weiss, with Skinner & Sherman, Inc., chemists and engineers, Boston, Mass., has been appointed a member of the Committee on Abstracts and Bibliography of U. S. Institute.

Abstracts and Bibliography

This section is compiled under the direction of the Committee on Abstracts and Bibliography: Prof. E. R. Schwartz, Chairman, Dr. W. E. Emley, Prof. Louis A. Olney and M. W. Weiss.

The Arrangement

Abstracts and Bibliography are arranged alphabetically by major subject under the following classifications:

I. Fibres (Synthetic and Natural) and Fibre Analysis.

II. Yarns and Fabrics.

III. Chemical and Other Processing (Not Otherwise Classified).

IV. Research Methods and Apparatus.

V. Economic Research and Miscellany.

Subjects are followed by name of author, and the abbreviated or complete title of the publication is followed by the year, volume, issue number or date, and the page number or numbers.

A key to abbreviations of publications abstracted was published in Vol. III, No. 1, Nov., 1932, pp. 58–9, and should be preserved for reference as it will not be published again in this volume. Abbreviations of additional publications abstracted are published in issues of their initial use.

Abstracts

I. Fibres (Synthetic and Natural) and Fibre Analysis

Birthcoat of the New Zealand Romney Lamb: The Pre-Natal Check in the. F. W. Dry. *J. T. I.*, 1933, V. 24, No. 4, P. T161.

The main interest in zoological work on wool lies in attempting to explain, in one set of terms or another, how the coat of the sheep comes to be what it is. Certain facts about the coat of the New Zealand Romney lamb are presented in the hope that their eventual interpretation will contribute to what may be called the zoological theory of the fleece. (S)

Blackface Wool: Sulphur-free Nature of Medulla in. J. Barritt and A. T. King. *Brit. Chem. Abs. A*, 1931, 1177 (from *Biochem. J.*, 1931, 25, 1075–6).

The average content of actual medulla substance is approximately 5.5 per cent. From the S content of medullated and unmedullated fibres and other data it is deduced that the medulla substance does not contain S. (Copied complete from *J. T. I.* Abstract Section, 1932, V. 23, P. A154.) (S)

Cellulose Acetate: Spinning Quality of. Fritz Ohl. *Kolloid Z*, 1933, V. 62, P. 85–91.

Spinning quality as measured by the length of fibre which can be drawn from a solution is independent of the acetate content, but is very dependent on the method of preparation of the acetate. For a given method the spinning quality increases with viscosity of the solution and shows a maximum at about 10% concentration. (Copied complete from *Chem. Abs.*, 1933, V. 27, P. 1747.) (W)

Cocoon: Effect of Moisture on Formation of, of Bombyx Mori. T. Watanabe. *Seide*, 1932, V. 37, P. 433–6 (see also *J. T. I.*, 1932, A634).

In cocoons spun in too humid an atmosphere the fibres are very difficult to separate from each other, have a high moisture content, swell relatively slightly in hot water, and have a small breaking strength when wet, whilst the solubility of the sericin in water is abnormally small. The cocoons are rather dark coloured, and the proportion exhibiting violet fluorescence in ultra-violet light is higher than with normal cocoons. The content of nitrogen, fats, wax, and ash, and the tinctorial properties of the fibre are not affected by variations of the humidity at the time of spinning. (Copied from *J. T. I.* Abs. Section, January, 1933.) (S)

Cotton: Effect of Atmospheric Humidity and Temperature on the Relation Between Moisture Content and Electrical Conductivity of. Albert C. Walker. *J. T. I.*, 1933, V. 24, No. 4, P. T145.

The data given in this paper show the effect of successive equilibrium humidity cycles on the relation between (a) relative humidity and moisture content; (b) insulation resistance and relative humidity; and (c) insulation resistance and moisture content, for raw and water-boiled cotton at

constant temperature (25° C.). These data have been of considerable assistance in explaining the behaviour of cotton, particularly the fact that its d.-c. insulation resistance, when measured at some definite test condition, is dependent, to a surprising extent, upon previous treatment, e.g. the manner in which wet cotton is dried, temperature of drying, and the atmospheric conditions to which it is exposed after drying, before being measured under the comparable test conditions.

The information secured as a result of this investigation has been valuable in improving the practical methods of inspection used to control the quality of textiles for electrical insulation in telephone apparatus.

Previously it was shown by Murphy and Walker that the relation between the insulation resistance (I.R.) and percentage moisture content (% M.C.) of cotton can be expressed by the equation—

$$\log \text{I.R.} = -\text{A} \log \% \text{ M.C.} + \text{B}.$$

The present work shows the relation to be as follows: Below 3% moisture content—

$$\log \text{I.R.} = -\text{A} \% \text{ M.C.} + \text{B}. \qquad \text{(I)}$$

Between 3% and 10% moisture content—

$$\log \text{I.R.} = -\text{A} \log \% \text{ M.C.} + \text{B}. \qquad \text{(II)}$$

Between 10% moisture content and saturation (about 25% M.C.)—

$$\log \text{I.R.} = -\text{A} \% \text{ R.H.} + \text{B}. \qquad \text{(III)}$$

Different values of A satisfy these equations, depending, as noted above, upon the previous treatment of the cotton and upon the direction of approach to equilibrium; whether this approach is from the dry state (along an adsorption cycle), or from the wet state (along a desorption cycle). The experimental data include results of tests on one sample of raw cotton and two of water-boiled cotton. The following tabulation gives some idea of the limiting values of A and the conditions under which they will satisfy the equations—

	Equation I			Equation II		Equation III
		Water			Water		Water
	Raw	Boiled	Raw	Boiled	Raw	Boiled
Abs.*	1.16	No	10.5 –11	12	0.143	0.111
Des.†	1.06	values	9.88–10.15	10.2	0.076	0.075

* Absorption. † Desorption. (S)

COTTON PLANT: BREEDING. A. Pankina. *Plant Breeding Abs.*, 1932, V. 2, P. 78–79 (from *Bull. Sci. Res. Cott. Inst.* Tashkent, 1931, 7–8, P. 29–35).

The success of any breeding work depends on the wealth of diversity of the original material. For this reason expeditions have been made and a collection built up which embraces all the diversity of all the cotton-growing countries in the world. Among the material collected are varieties which under the conditions of Central Asia show no signs of boll-production until advanced autumn. Over 500 specimens of these are under investigation and they possess a great number of very valuable characters. Some of these have large bolls weighing up to 8 gm. Early ripening Egyptian types with bolls weighing 3–3.5 gm. have appeared. Many of the late types have proved highly drought-resistant, suitable for poor soils

and resistant to a variety of diseases. The only difficulty is in inducing them to flower. For this purpose various methods have been tried, e.g.: (1) Transplantation after indoor germination during the spring frosts. A lengthening of the period of vegetation of two to three months was thus obtained and some of the late varieties were brought successfully to maturity. (2) Green-house cultivation of plants which have failed to give seed in the field. Various disadvantages of this method are enumerated and it is only used to a limited extent. (3) Grafting. By grafting on to early varieties, late ripening plants can be greatly accelerated in their maturity. Late plants which have not matured in the field are also grafted on to plants growing in the greenhouse and so brought to maturity. (4) Cuttings—with the object of enabling late ripening forms to complete their period of maturity in the greenhouse and also as a means of multiplying rare plants or valuable heterozygous plants obtained by hybridization, e.g., in the case of interspecific crossing, the hybrid *G. hirsutum* X *G. barbadense* being an example. The method of taking the cuttings is briefly described. Many groups of cotton, e.g., *G. punctatum*, are not capable of vegetative propagation in these ways and suffer severely even from transplanting; in no case were the results fully satisfactory and the search for better methods is being continued. (5) Length of day treatment. The cotton plant has been shown to be a short day plant, and by artificially reducing the period of insolation flowering and ripening can be very much accelerated. In this way perennial cottons have been made to flower simultaneously with the local ones and valuable crosses effected, e.g., Egyptian with large-bolled forms of *G. peruvianum*, resulting in a considerable rise in boll weight of the early Egyptian types. The progeny are now in F_2 and are being further analyzed. (Copied complete from *J. T. I.* Abstract Section, 1932, V. 23, P. A156.) (S)

Mildew in Silk. D. S. Chamberlin. *Mell. Tex. Mo.*, 1933, April, P. 25–6; *ibid*, May, P. 51–2.

Briefly describes the species of molds or fungi met with in silk, and the conditions and processes favoring their development, but devotes the balance of the article to mildew problems in silk hosiery yarns, with special reference to detection and prevention of mildew. (C)

Pigments of Cocoons and of Eggs in Various Species of Silkworms. Flavones. G. Jucci. *Bollet. soc. ital. biol. sper.*, 1932, V. 7, P. 573–575 (through *Chem. Abs.*, 1932, 26, 5666).

The fact that the dirty yellow colour of green Japanese cocoons does not occur in other cocoons is due to the flavones, which are the pigments of green cocoons being attacked by alkaline substances, whilst the carotenoids, which are responsible for the colours of the other cocoons, are unattacked. (Copied from *J. T. I.* Abs. Section, January, 1933.) (S)

Staple Length Variation and Distribution in the Fleece of the Merino. J. E. Duerden and E. W. Palmer. *18th Rep. Director. Veterinary Services and Animal Industry*, S. Africa, 1932, Part II, P. 991–1003.

The variability in length of the fleece of the Merino sheep, and its distribution over the different parts of the body, are studied, based on staple measurements of woolled skins and of the live animal. No sharp line of

separation can be drawn between the staple lengths over adjacent areas, but a gradient exists from before, backwards and downwards. The distribution of the measurements reveals that the wool covering the body and sides of the sheep represents 58% of the whole area of the unskirted fleece; that covering the neck is 22% of the whole; that over the belly, points and britch is 20%. Approximately the Merino fleece may be regarded as comprising one-half body-length wool, one-quarter neck-length wool, and one-quarter belly and britch wool. The staple length distribution does not closely correspond with the quality or thickness distribution. So far as any single staple is concerned, a direct-correlation exists between the length and thickness of the individual fibres, but no correlation holds when the wools from distant areas of a sheep are compared. (Copied complete from *J. T. I.* Abstract Section, April 1933.) (S)

II. Yarns and Fabrics

Artificial Leather under the Microscope. W. M. Munzinger. *Kunststoffe,* December 1932, P. 265–7.

Six photomicrographs are included showing the built-up structure of the artificial leather and the identification of imperfections such as air pockets and pores. The usefulness of the microscope in determining the particle size of the pigment and especially the relation of the size of pigment particles in the lacquer layer to the resultant antique effect are also pointed out. (Copied from *Eastman Kodak Abs. Bull.,* Feb. 1933.) (S)

Cotton Cloth Finishing: Technical Control in. M. Martin Charap. *Mell. Tex. Mo.,* 1933, May, P. 49–51.

Deals with variations which occur in the cotton finishing department and suggests methods of control for some of them. Accompanied by a table showing moisture content of starch at various relative humidities, and a humidity correction chart for starches. (C)

Weaving Qualities of Synthetic Yarn Lining Fabrics and Methods Used in Testing. Charles L. Simon. *Mell. Tex. Mo.,* 1933, April, P. 13–4; *ibid,* May, P. 58–9.

In this paper, originally presented before the Textile Section of A. S. M. E., Feb. 7, 1933, the author explains that the "Perspirator" machine for testing wear of linings was developed after a thorough study of actual wear of such fabrics and to simulate the latter. The theory of the machine, the method of conducting tests, the rating of wearing quality, and factors affecting wearing quality are explained and discussed. (C)

III. Chemical and Other Processing (Not Otherwise Classified)

Acid Dyestuffs on Piece Goods. Douglas Kermode. *Dyer,* 1932, V. 68, P. 623–4.

The following dyestuffs used on wool are briefly discussed: Napthol Yellow S; Indian Yellows and Citronines; Tartrazine; Orange II; Indigo Extract and Indigo Carmine; Wool Green S; Patent Blue A types; Acid Reds of the 2G and 6B types; and Acid Brown Combinations. (Copied complete from *Chem. Abs.,* 1933, V. 27, P. 1759.) (W)

CARBOHYDRATE ACETATES: THE DETERMINATION OF THE ACETYL CONTENT OF: Herbert L. Parsons. *J. T. I.*, 1933, V. 24, No. 4, P. T167.

The determination of the acetyl content of carbohydrate acetates is an operation of some importance for industrial as well as for purely academic purposes. From the point of view of the textile industry it is important, first, in the control of the manufacture of acetate rayon and of 'immunised' cotton, and secondly, in the control of the finishing processes involving the partial or complete hydrolysis of these materials. There is thus a need for an examination of methods that may be used for the purpose; the present paper describes a method that has some advantages over those now in common use. The most promising one is that which involves hydrolysis of the material with fairly concentrated cold sulphuric acid followed by the isolation of the acetic acid produced by extraction with ether. Its chief advantage over the classical method employing acid hydrolysis and steam distillation lies in the fact that many samples can be dealt with simultaneously by one operator. It is possible, for example, for one person to carry through a dozen determinations at one time by this method, an operation that would require an impracticably large amount of apparatus and bench space if it were attempted by the steam distillation method. The method is an absolute one and the experimental constant is found to be the same for all the carbohydrate acetates examined, provided that ether purified as described is employed. (S)

COTTON PRINTING: PRODUCTION OF BLACK AND GRAY UNDER SULFUR COLORS. L. Goubyrin. *Bull. soc. ind. Mulhouse*, 1932, V. 98, P. 559–61 (sealed note of 1910). Report, Arthur Lauter, *ibid.*, P. 561.

Nitroso dimethyl aniline is printed with resorcinol on white mercerized cotton, and, after steaming for 5 minutes, the cloth is foularded with a solution of sulfur colors. Grays of different intensity are obtained by adding zinc chloride colors and reducing the amount of nitroso dimethyl aniline. The dyeings are fast to washing. Lauter reports that the process is new and successful. (Copied complete from *Chem. Abs.*, 1933, V. 27, P. 1759.) (W)

COTTON PRINTING: SULFUR COLORS IN. B. J. Cheshire. *Bull. soc. ind. Mulhouse*, 1932, V. 98, P. 555–7 (sealed note of 1910). Report, G. Tagliani, ibid., P. 557–8.

To avoid corrosion of the copper apparatus by alkali sulfides, it is proposed to use sodium sulfide in the form of a compound with formaldehyde, which decomposes during the subsequent steaming. Mix 2 kg. of 40% formalin with 1 kg. of bisulfite of 36° Baume. Cool to 5°. Slowly add 1 kg. of calcined sodium sulfide (65%). Tagliani reports that the method appears to be new and successful. Crystal sod. sulfide is not satisfactory. (Copied complete from *Chem. Abs.*, 1933, V. 27, P. 1759.) (W)

DYEING CELLULOSE: RECENT INVESTIGATIONS IN. W. Wetzien and K. Schultze. *Kolloid Z.*, 1933, V. 62, P. 46–54; cf. *Chem. Abs.*, V. 24, P. 5161–2, 6021; V. 25, P. 819.

The substantive dyeing process is more complicated than is generally supposed. The concentration of salt and the temperature required to reach maximum dye absorption increase with unevenness of dyeing; even dyeing

usually shows the maximum in the range of 50–70°. Electrolyte-free water removes 90% of the dye in a few washings; the red and yellow even dyes are easier to remove than the blue from viscose. Electrolytes in low concentration decrease the rate of removal by washing. (Copied complete from *Chem. Abs.*, 1933, V. 27, P. 1759.) (W)

RAYON: USE OF INDANTHRENE DYES TO DETECT LINSEED OIL IN. Giuseppe Antonelli. *Tinctoria*, 1932, V. 31, P. 493.

Several unreduced indanthrene dyes act as substantive dyes on rayon in the presence of linseed oil. This reaction can be used to show whether the textiles were perfectly degummed or traces of oil remain on the tissue. By dyeing the samples with Brilliant Rose R, Scarlet GG, Brown G or GG, Red Violet RH, the rayon containing linseed oil is dyed and the raw rayon is not. (Copied complete from *Chem. Abs.*, 1933, V. 27, P. 1759.) (W)

VISCOSE: NEW METHOD FOR DETECTING FREE SULFUR IN. A Castiglioni *Z. anal. Chem.*, 1933, V. 91, P. 346–9; *Chem. Abs.*, 1933, V. 27, P. 1591.

Five cc. of acetone and a few decigrams of potassium cyanide are added to a little of the substance, then heated to boiling, cooled, and the acetone poured off. The acetone is acidified with nitric acid and a drop of ferric nitrate solution added. If free sulfur is present in the original viscose, red ferric thiocyanate is formed. (W)

WETTING-OUT OR SINKING TESTS: COMPARISON OF THE ROSETTE AND FLANNEL COTTON METHODS OF. Albert H. Grimshaw. *Mell. Tex. Mo.*, 1933, April, P. 15–17.

The tests of these simple wetting-out processes were made for comparison of methods rather than comparison of substances used, although it was found that, of several SO_3 compounds used, the Oleo Glyceryl Sulphate containing the larger amount of SO_3 was better or quicker as regards wetting-out and did not break down in the acid test. It was found that the rosettes were easier to handle than the flannel, but the tests did not prove which was the more accurate. (C)

WOOL: SOME EXPERIMENTS ON CHLORINATION OF. H. R. Hirst and A. T. King. *J. T. I.*, 1933, V. 24, No. 4, P. T174.

This paper is a record of the effects of the chlorination process applied under a wide variety of conditions, mainly from the practical standpoints of unshrinkability, strength, colour, handle, and level dyeing. The object was not to examine the purely theoretical aspect of the action of chlorine on wool, but to illustrate (1) the varying practical effects of applying a given percentage of 'available' chlorine (as chlorine gas, 'nascent' chlorine, or hypochlorous acid) under different conditions notably in respect of the amount of acid used, and (2) the extreme importance of uniform application of the chlorinating medium, apart from its mode of preparation, and the condition of the fabric prior to its chlorination. (S)

Bibliography

I. Fibres (Synthetic and Natural) and Fibre Analysis

Benzyl Cellulose. A. Jones. *Brit. Plastics*, 4: Dec., 1932, P. 292–3.

Brief descriptions are given of the cellulose ethers, particularly benzyl cellulose. (Copied from *Eastman Kodak Abs. Bull.*, Feb., 1933.) (S)

Cellulose: Structure. D. Krüger. *Zellstoff u. Papier*, 1933, V. 13, P. 9–12; *Chem. Abs.*, 1933, V. 27, P. 1746.

A review and discussion, with 28 references, of the recent literature on the methods of determining the structure of the cellulose fibres. (W)

Cellulose and Rayon. Ernst Berl. *J. Roy. Coll. Sci.*, 1932, V. 2, P. 9–18.

A review. (Copied complete from *Chem. Abs.*, 1933, V. 27, P. 1747.) (W)

Cotton: Naturally Occurring Ash Constituents of. Distribution of Ash Constituents as Salts and Changes Resulting from Washing in Aqueous Solutions. A. C. Walker and M. H. Quell. *J. T. I.*, Mar., 1933, P. T131.

Information on the inorganic ash constituents deposited in cotton fibre during growth is valuable. It is pointed out that an ionic interchange occurs when cotton is washed in aqueous salt solutions. (S)

Cotton: Physiological and Genetic Aspects in Hair Properties of Egyptian. C. H. Brown, A. E. G. Selim and A. Youssef. Ministry Agr. Egypt, *Tech. Sci. Service, Bull.*, 123, 1932, 19 pp.; *Chem. Abs.*, 1933, V. 27, P. 1761. (W)

Iron in Green Japanese Silkworm Cocoons: Presence of. C. Manunta. *Bollet. soc. ital. biol. sper.*, 1932, V. 7, P. 667–70) (through *Chem. Abs.*, 1932, 26, 5667).

These cocoons have a greater content of iron than some others, and the iron may be responsible for 'rust.' Part of the iron can be extracted by treatment with water. (Copied from *J. T. I.*, January, 1933.) (S)

Plasticization of Cellulose Acetate. V. E. Yarsley. *Brit. Plastics*, 1932, V. 4, P. 266–8.

Short summaries are given of recent patent specifications dealing with the plasticization of cellulose acetate. (Copied from *Eastman Kodak Abs. Bull.*, Feb., 1933.) (S)

Rayon Fibre: Cohesion in the, as a Function of its Laminated Structure. L. A. Van Bergen. *Chem. W'blad.*, 1933, V. 30, P. 55–8; *Chem. Abs.*, 1933, V. 27, P. 1504.

A theoretical discussion. (W)

WOOL: SULPHUR CONTENT OF. PART IV. FURTHER EVIDENCE OF THE VARIABLE SULPHUR CONTENT OF WOOL. J. Barritt and A. T. King. *J. T. I.*, Mar., 1933, P. T119.

The paper deals with a comparison of the sulphur contents of wools purified by specific methods, and the results obtained by examination of a series of Scotch wools. (S)

II. YARNS AND FABRICS

COTTON FABRIC: THE EFFECT OF SUNLIGHT AND OTHER FACTORS ON THE STRENGTH AND COLOR OF. Mary Anna Grimes. *Bulletin No. 474*, February, 1933. The Agricultural and Mechanical College of Texas.

Twenty-two cotton fabrics, some white and some colored, were made a part of the research work. (S)

FIREPROOFING CLOTH. R. Chesneau. *Bull. soc. ind. Rouen*, 1932, V. 60, P. 265–75; *Chem. Abs.*, 1933, V. 27, P. 1261.

A review. (W)

III. CHEMICAL AND OTHER PROCESSING (NOT OTHERWISE CLASSIFIED)

ACTIVATED CARBONS IN THE TEXTILE INDUSTRY. S. Reginald Price. *Dyer*, 1933, V. 69, P. 75–6; *Chem. Abs.*, 1933, V. 27, P. 1760–1. (W)

BLEACHING, DYEING AND PRINTING OF FABRICS: NOTES ON HISTORY OF. A. Bley. *Tiba*, 1932, V. 10, P. 933–9, 1005–13; 1933, V. 11, P. 26–31; *Chem. Abs.*, 1933, V. 27, P. 1760. (W)

COTTON: NOTE ON DYEING PRUSSIAN BLUE ON. E. Justin Mueller. *Bull. soc. ind. Rouen*, 1932, V. 60, P. 276–9; *Chem. Abs.*, 1933, V. 27, P. 1759. (W)

DYES DERIVED FROM ACENAPHTHENE QUINONE. III. AZINE AND INDIGOID VAT DYES. Sisir K. Guba. *J. Indian Chem. Soc.*, 1932, V. 9, P. 423–7; *Chem. Abs.*, 1933, V. 27, P. 1758. (W)

FALSE ECONOMIES IN PRODUCTION OF VAT-DYED COTTON-PIECE GOODS. D. L. Willaston. *Dyer*, 1932, V. 68, P. 507–8, 559–60; *Chem. Abs.*, 1933, V. 27, P. 1760. (W)

IV. RESEARCH METHODS AND APPARATUS

PROJECTOR: TEXTILE. Warren P. Seem. *Am. Silk and Rayon Jnl.*, 1933, V. 52, No. 3, P. 33–4.

A brief description of possible uses of a newly designed instrument for the study of regularity and faults in textile materials. (S)

ULTRA-VIOLET RAYS IN INDUSTRY: FLUORESCENCE AND FADING TESTS. *Manchester Guardian Commercial*, Feb. 4, 1933, V. 26. See Monthly Abstr. Bull., January, 1933, P. 13. (Copied from *Eastman Kodak Abs. Bull.*, Feb., 1933.) (S)